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(54) **METHOD, APPARATUS FOR RECOVERING ABRASIVE POWDERS**

**VERFAHREN UND VORRICHTUNG ZUR RÜCKGEWINNUNG VON SCHLEIFPULVER**

**PROCEDE ET APPAREIL DE RECUPERATION DE POUDRES ABRASIVES**

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**US-A- 5 197 876** **US-A- 5 356 292**

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## Description

### TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates in general to dental polishers and other related equipment, and more particularly to a device attached thereto or made integral therewith for containing the residue of air-driven abrasive powders, thereby reducing the amount of the abrasive powder that becomes airborne and otherwise distributed in the immediate environment.

### BACKGROUND OF THE INVENTION

[0002] Abrasive-driven polishers are well known in the medical and dental fields for removing undesired deposits from hard tissues, such as teeth, bones, etc. For example, a sodium bicarbonate powder is frequently used as the abrasive medium which is pressurized and directed toward a tooth surface to remove plaque and other types of deposits. In such an operation, air, pressurized to about 30-50 psi, carries the abrasive powder in an air stream that is directed through a small nozzle toward the surface to be cleaned. This forced air stream is pressurized sufficiently to achieve sufficient force to abrade, remove stains and dislodge or wear away the deposits. As can be appreciated, the air-driven abrasive powder is effective to remove the undesired deposits, but is also distributed on nearby surfaces and equipment, as well as becomes airborne. In a typical abrasive cleaning operation, the abrasive powder residue is distributed in the air and leaves a fine layer of powder or dust on everything that is within 10-20 feet of the cleaning operation. The abrasive powder not only provides an unsanitary environment, but such powder can be carried on clothing and footwear as persons leave the area of abrasive cleaning. Further, the airborne powder can carry with it contaminated body fluids, and thus functions as a carrier to contaminate yet other areas by being carried by clothing, footwear, equipment parts, wheeled carts, as well as the ventilation system. The disadvantage of the airborne abrasive powder is thus apparent.

[0003] Hand-held abrasive cleaners are readily available which, when connected to a source of air pressure, allow the abrasive powder held in a container to be carried by the air stream and through a nozzle in the end of the hand piece. The instrument can be manipulated so as to direct the air-driven abrasive powder toward the surface to be cleaned. It is mandatory that the dental assistants, as well as the doctor, wear facial masks to prevent inhaling or ingestion of the powder. Other polishers include ultrasonic hand pieces which have an inner, small tubular member for carrying the air-driven abrasive, and an outer tubular member concentric therewith, for carrying a jetted water stream. In the ultrasonic version of the polisher, the water and/or powder jetted from the ultrasonic-vibrating tip is believed to provide a cavitation function for facilitating removal of the

deposits with the air-driven abrasive powder. While these and other types of abrasive polishers are well adapted for cleaning hard tissue surfaces, the inherent problems described above have yet to be overcome. Indeed, because of the extreme consequences of air contamination in a hospital environment, such devices are in jeopardy of being discontinued by enforcement of OSHA regulations.

[0004] U.S. Pat. No. 5,145,367 by *Kasten* describes an attachment according to the first part of claim 1. It describes a vacuum-operated instrument for treatment of the crevices between tooth and gum tissue. The instrument, to which a pulsing vacuum is applied, includes a replaceable, flexible skirt that is pushed against the gum and tooth to provide a confined area. Momentary vacuum is then applied to the confined area to withdraw liquid or other matter from the crevice between the tooth and the gum. Once the vacuum is interrupted, a treatment fluid is introduced into the confined area, and the capillary action in the crevice draws the treatment fluid therein.

[0005] In view of the foregoing, it can be seen that a need exists for a structure that fits on the end of an abrasive polisher to contain the air-driven abrasive powder and prevent the same from becoming airborne. Another need exists for a flexible guard that is fittable on the nozzle of an air-driven polisher, and connectable to a source of suction for containing the abrasive powder to the immediate surface to be cleaned, as well as facilitate the removal of the powder residue, all without substantially interfering with the cleaning operation. Another need exists for a disposable unit that is fittable on the nozzle of a polisher for containing and recovering the powder residue, and which is cost effective so as to be readily disposable.

### SUMMARY OF THE INVENTION

[0006] This invention relates to a device as claimed in claim 1 and to a method as claimed in claim 19.

[0007] In accordance with the principles and concepts of the invention, the attachment disclosed is for use with an air abrasive instrument for containing and collecting the abrasive powder that is left as a residue on the cleaned or polished surface. According to the preferred embodiment of the invention, a suction attachment includes a plastic body having a general cylinder shape with a bore formed in one end thereof for friction fitting onto the tubular nozzle of the air abrasive instrument. A larger diameter bore is formed in the other end of the attachment body to form an annular suction chamber. A suction tube is formed in the sidewall of the attachment body, with a suction bore in communication with the suction chamber. The suction tube is connected to a source of suction by a flexible hose.

[0008] A flexible rubber skirt is friction fit on the end of the attachment body such that the suction chamber is essentially extended by the rubber skirting. In a pre-

ferred form of the invention, the end of the attachment body includes an external, annular groove in which a rim of the rubber skirt fits to attach the skirting to the attachment body. When the suction attachment is pressed onto the tubular nozzle of an air abrasive instrument, the end of the nozzle is disposed well within the rubber skirting to direct a jet of abrasive powder toward the surface to be cleaned, while the skirting is sealed to the surface to contain the powder residue.

[0009] The method of utilizing the suction attachment of the invention is to attach the suction attachment to the nozzle of an air abrasive instrument, and connect the suction tube to a source of suction. The suction attachment, and particularly the annular edge of the rubber skirting, is pressed against the surface to be cleaned, and then the pressurized air-driven abrasive is allowed to be jetted from the nozzle toward the surface. The rubber skirting encloses the area to be cleaned and prevents escape of airborne abrasive residue. Importantly, the source of suction formed in the suction chamber of the attachment body and extended by the rubber skirting, collects the powder abrasive residue after it has been jetted toward the surface to be cleaned. The powder residue is thus contained and recovered and does not contaminate the surrounding environment. In accordance with an important feature of the invention, the air abrasive instrument can be moved along the surface to be cleaned, while the flexible skirt maintains engaged and sealed to the surface to prevent escape of the abrasive powder. Also, the abrasive nozzle can be oriented at various angles with respect to the surface to be cleaned, while the rubber skirting maintains a peripheral engagement with the surface, again preventing escape of airborne abrasive powders.

[0010] While a suction is employed in the preferred embodiment, the device will also function without the application of suction to the rubber skirting. In another embodiment, the air pressure itself is employed as the mechanism to carry the abrasive powder to the tooth surface, as well as the mechanism to force the used abrasive from the tooth surface out of an exit tube to a waste container.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Further features and advantages of the present invention will become apparent from the following and more particular description of the preferred and other embodiments, as illustrated in the accompanying drawings in which like reference characters generally refer to the same or similar elements or functions throughout the views, and in which:

FIG. 1 is a generalized view of the suction attachment of the invention, as attached to the nozzle of an air abrasive instrument;

FIG. 2 is a cross-sectional view of the suction attachment body removed from the flexible skirt;

FIG. 3 is an end view of the open end of the flexible skirt;

FIG. 4 is a cross-sectional view of the suction attachment as utilized with an air abrasive instrument to polish or clean a tooth surface;

FIG. 5 is a cross-sectional view of another embodiment of the suction attachment body that is well adapted for use with an angled nozzle;

FIG. 6 is a cross-sectional view of another embodiment of an attachment body, having an internal shoulder stop engagable with a shouldered nozzle; and

FIG. 7 is a side view of a stop member adapted for fastening to a nozzle for providing a stop for the attachment body.

#### DETAILED DESCRIPTION OF THE INVENTION

[0012] The suction attachment device of the invention is well adapted for use with ultrasonic polishers which utilize an ultrasonic tip that jets a mixture of water and air-driven abrasive powders to a surface to be cleaned, as well as the general type of dental or medical polisher which simply uses a nozzle for directing a stream of air-driven abrasive powders to a surface to be polished or cleaned. Of course, the suction attachment described below can be utilized with other types of nozzles carrying abrasive or other types of powders, in which it is desired to recover the residue of the powders and prevent the same from becoming airborne and contaminating the immediate environment.

[0013] With reference now to FIG. 1 of the drawings, there is shown the suction attachment 10, as installed on the nozzle end 12 of an air abrasive instrument 14. Typical air abrasive instruments 14 are connected to an abrasive powder/air pressure supply 16 of about 207-345 kPa (30-50 psi), where the abrasive powder is carried with pressurized air through the instrument 14 to the nozzle 12. Sodium bicarbonate is a typical abrasive powder used in dental polishers. In the case of ultrasonic abrasive instruments, it is connected to an ultrasonic power supply 18 as well as a water pressure supply 20. In the ultrasonic type of air abrasive instruments, the nozzle 12 includes an outer tube carrying a water stream that is agitated by the ultrasonic vibrations to provide a cavitation function to facilitate cleaning of the surface. An inner tube of the nozzle 12 carries the air-driven abrasive powders that are directed under pressure toward the surface to be cleaned. The water carried through the ultrasonic air abrasive instrument also functions to cool the device to remove the thermal energy generated by the ultrasonic-driven mechanism.

[0014] The suction attachment 10 includes a body 22 that is suitably attached at one end thereof to a nozzle, and at the other end to a flexible rubber skirt 24. Formed integral with the attachment body 22 is a suction tube 26 that is connected by a hose 28 to a suction source 30. Suction equipment generally available in dental and

medical operations is suitable for use as the suction source 30 with the present invention. While not shown, a switch or control can be utilized to manually apply or remove the suction, or adjust the amount of suction applied to the suction attachment 10 during use thereof. Also not shown in FIG. 1, the end of the nozzle 12 projects through the attachment body 22 into the flexible skirting 24. The flexible skirting 24 provides a cylindrical air-tight enclosure when pressed against a surface to contain the air-driven abrasive powders. The residue of the abrasive powders is contained and recovered through the suction tube 26 and collected at the suction source 30. When utilized in conjunction with instruments where water is jetted toward the surface to be cleaned, the powder residue as well as the water and mist is removed via the suction source 30.

[0015] FIG. 2 illustrates in more detail the structural features of the suction attachment 10. The attachment body 22 is barrel-shaped and preferably formed of a high density polyethylene plastic. At the nozzle entrance end of the body 22, there is formed a bore 34 having a diameter for friction fitting onto the tubular nozzle 12. A second bore 36 is formed in axial alignment with the first bore 34, but is of a larger diameter than the first bore 34. The second bore 36 is larger than the outside diameter of the nozzle 12 to thereby form an annular suction chamber therearound. The suction tube 26 is formed integral with the body 22 and includes a suction bore 38 that extends through the sidewall of the body 22 and is in communication with the suction chamber defined by the large-diameter bore 36. When a source of suction 30 is connected to the suction tube 26, the suction extends into the annular suction chamber formed by the bore 36, and functions in a manner described below. The body 22 of the suction attachment 10 further includes an annular groove 40 formed at the suction chamber end of the body 22 for attachment of the flexible skirting 24.

[0016] The flexible skirting 24 is constructed of a pliable rubber or other type of material to provide a high degree of flexibility thereto. In the preferred embodiment, the flexible skirting 24 includes an inwardly-directed rim 42 for engagement within the annular groove 40 of the attachment body 22. With this construction, the flexible skirting 24 can be quickly affixed and held in an air-tight manner to the attachment body 22, while the peripheral edge 32 of the skirting is sealed against a surface. Such arrangement allows the air abrasive instrument nozzle 12 to be rotated or otherwise moved about to direct or sweep the stream of abrasive powders across the area to be polished. It should be noted that the groove 40 and the rim 42 can be reversed with respect to placement on the attachment body 22 and the skirting 24. The flexible skirting 24 is generally cylindrical in shape, but can be tapered outwardly as shown in FIG. 2, to increase the surface area to be contained. The flexible skirting 24 extends the annular suction chamber formed by the large-diameter bore 36, to the surface to

be polished. The flexible skirting 24 also includes an annular peripheral edge 32 for engagement with the surface to be cleaned. Further, the skirting 24 includes a number of inwardly, radially extending webs 44 to provide a certain degree of rigidity, and to prevent collapse of the cylindrical sidewall of the skirting when suction is applied to the attachment device 10.

[0017] A flexible skirting member well adapted for use with the invention is obtainable as an attachment to a "Prophy Angle" device, manufactured by Young Dental Manufacturing, located at Earth City, Missouri. Another flexible skirting well adapted for use with the invention is obtainable from Crescent Dental Manufacturing Company, Lyons, Illinois. The flexible skirting provided with the Prophy Angle device requires removal of the threaded stud therefrom, so that the remaining bore can be enlarged and friction fit onto the end of the attachment body 22. In the other flexible skirting, it must be modified according to the following procedures. A hole can be punched through the portion of the rubber "prophy cup" that is designed to snap fit over the edge of the prophy angle. This procedure will create an annulus for the abrasive tube to extend into the flexible portion of the prophy cup.

[0018] When specifically molded for use with the attachment body 22, the flexible skirting 24 can include the rim 42 and the other structure shown in FIGS. 2 and 3. Indeed, those skilled in the art may find that it is preferable to utilize a transparent flexible rubber or plastic so that the operator of the air abrasive instrument 14 can observe the cleaning operation in the area contained by the flexible skirting 24.

[0019] With reference to FIG. 4, there is depicted the use of the suction attachment 10 in conjunction with an air abrasive instrument 14 for cleaning or polishing the surface of a tooth 50. The attachment body 22 is shown friction fit to the nozzle 12 to provide an air-tight connection. The nozzle 12 extends through the attachment body 22, with the suction chamber 36 therearound, in communication with the suction bore 38 of the suction tube 26. The operator can press the attachment body 22 onto the tubular nozzle 12 to the extent necessary to place the tip of the nozzle 12 a desired distance from the tooth surface while the flexible skirting 24 engages the tooth. The flexible skirting 24 is urged forward by the instrument 14 so that its peripheral edge 32 engages and seals to the surface of the tooth 50 and provides an enclosed or contained area 52 to prevent escape of the air-driven abrasive powders. The end or tip 54 of the nozzle 12 is spaced a short distance (about 1-3 mm) from the peripheral edge 32 of the flexible skirting 24 to provide working room between the nozzle tip 54 and the tooth surface 50. To that end, the peripheral edge 32 of the flexible skirting 24 can remain engaged and sealed to the tooth surface 50, while the air abrasive instrument 14 and the nozzle 12 is either rotated, swayed or oriented at different angles with respect to the tooth surface 50. Then, before the operator moves the peripheral

edge 32 of the skirting 24 to another surface area to be cleaned, the stream of abrasive powders can be interrupted by manually operated controls (not shown), while the suction source still remains in operation to remove the remaining airborne powders or residue within the contained area 52. When the powder residue has been completely removed from the contained area 52, the air abrasive instrument 14 and the suction attachment 10 can be lifted or otherwise moved to another surface area to be polished. It can be seen from FIG. 4 that a circulation path exists from the end of the nozzle 12, to the tooth surface, and back to the suction tube 26. The suction source 30 connected to the suction tube 26 enhances the circulation of spent abrasive powders, for removal and containment at the suction source 30.

**[0020]** The present invention may be readily adapted for use in removing the abrasive powders and aerosol contaminants without the use of suction. In other words, rather than connecting the suction tube 26 to a source of suction, the tube can be connected to a container for collecting the powder and aerosol residue without releasing the same to the atmosphere. In this alternate mode of operation, the pressurized air stream exiting the nozzle 12 is effective not only to abrade the tooth surface with the powder, but also to carry the powder residue and aerosol contaminants through the exit tube 26 to the container. The pressurized air stream creates a circulation path, without the use of suction, from the nozzle 12, to the tooth surface, and then through to exit tube 26 to a container. In this mode of operation, the container would need a filtered opening to the atmosphere to allow a free passage of air to maintain a circulation path, without pressurizing the container, and without releasing the contaminants to the atmosphere. The container itself can be a filter bag or enclosure connected via a tube or hose to the exit tube 26.

**[0021]** FIG. 5 illustrates another embodiment of an attachment body 60. The attachment body 60 is similar to the attachment body 22 described above, but includes a small-diameter bore 62 that has a removed area 64 to accommodate a sharp angle or bend in the tubular nozzle 12 of the air abrasive instrument 14. The removed or cupped area 64 receives the bend or angle of the tubular nozzle and prevents rotation of the attachment body 60 with respect to the nozzle 12. Further, the attachment body 60 is pushed onto the tubular nozzle 12 until the cupped surface of the removed area 64 engages the bend in the nozzle, thereby fixing or seating the parts together. In this manner, the attachment body 60 becomes fixed in position with respect to the nozzle, thus also fixing the end 54 of the nozzle a predefined distance from the peripheral edge 32 of the flexible skirt 24.

**[0022]** In accordance with another embodiment of the invention, FIG. 6 illustrates an attachment body 70 adapted for use with a tubular nozzle 72 that has a shoulder 74. The attachment body 70 includes an inwardly-directed edge 76 providing a stop when engaged

with the shoulder 74 of the nozzle 72. The internal edge 78 of the attachment body 70 can be dimensioned to be friction fit on the smaller diameter portion 80 of the nozzle 72. In like manner, the bore 82 of the attachment body 70 can be dimensioned to friction fit with the larger diameter portion 84 of the nozzle 72. With this construction, the suction attachment 70 is friction fit with respect to the nozzle 72 to provide an air-tight engagement, and provides a specified relationship by which the suction attachment 70 can be longitudinally engaged on the shouldered nozzle 72.

**[0023]** Another embodiment of a stop mechanism for positioning the attachment body with respect to the nozzle 12 is shown in FIG. 7. Here, a collar 90, constructed of plastic or other suitable material, is formed with a bore 92 for receiving therein the tubular nozzle 12. A transverse internally threaded bore 94 is formed in the collar 90 for receiving a set screw 96. The set screw can be utilized to fasten the collar 90 to the nozzle 12. In this manner, the suction attachment 22, such as shown in FIGS. 1 and 2, can be installed on the nozzle 12 and abutted against the collar 90. This prevents the suction tube 12 from being pushed through the small-diameter bore 34 of the suction attachment 10 when the instrument 14 is pressed against a surface to be polished.

**[0024]** From the foregoing, disclosed are various embodiments depicting the principles and concepts of the invention. The suction attachment can be economically fabricated of plastic or other suitable material so that it is cost effective, and thus disposable. In like manner, the flexible skirt 24 is also economically constructed and thus is considered disposable. The suction attachment as well as the flexible skirting can be used on a single patient and then disposed. In the alternative, the suction attachment can be sterilized or otherwise cleaned, while the flexible skirting can be used once and disposed of, and a new skirting reattached to the sterilized suction attachment. Further, those skilled in the art may find a suitable material for fabricating the suction attachment integral with the flexible skirting, and formed as a unitary unit. Those skilled in the art may also appreciate that the attachment body of the invention can be made as an integral part of the abrasive instrument nozzle, in which event the flexible skirting is the only disposable element. In this alternative, the air abrasive instrument may be fabricated with an internal suction channel in the instrument that is connected through the nozzle to the annular suction chamber, without the use of the external suction tube and associated hose that are shown in FIG. 1. Also, the attachment body can be formed with an internal annular groove to accommodate an o-ring to seal the unit to the nozzle.

**[0025]** Lastly, the aerosol recovery assembly disclosed in U.S. Pat. No. 5,378,150, by Harrel, entitled Method and Apparatus for Controlling the Aerosol Envelope Generated by Ultrasonic Devices, can be advantageously utilized in conjunction with the present invention. While the invention. While the abrasive polisher de-

vice describe herein will reduce a large percentage of the aerosol contamination, there may be a small percentage of the abrasive lost due to irregularities on the tooth surface or due to spaces between the teeth. In order to capture the small amount of abrasive material that may escape from the flexible skirting, as well as any aerosols of blood or saliva that are generated, the aerosol recovery assembly of the related patent application can also be fitted to the handle of the abrasive polisher. The combination of the abrasive polisher device and the aerosol recovery assembly will eliminate virtually all of the airborne contamination that is produced. Further, when the described invention is used with the aerosol recovery assembly, the suction tube 26 can be attached to the cylindrical body of the aerosol recovery assembly, which then will pull the abrasive powder and other contaminants from the operating site. This arrangement eliminates the need for a separate suction hose.

[0026] Thus, while the preferred and other embodiments of the invention have been disclosed with reference to specific structures and functions, it is to be understood that many changes in detail may be made as a matter of engineering choices without departing from the scope of the invention, as defined by the appended claims. Further, various features or combinations of the apparatus described above can be utilized separately, or together to realize the various individual advantages of the invention.

#### Claims

1. An attachment (10) for use in preparing a surface (50) of a workpiece, including a flexible skirt (24) for engaging the surface (50) to be prepared and providing an enclosed area (52) around the surface (50) to be prepared, a source (30) of suction coupled to the enclosed area (52) via the flexible skirt (24) said flexible skirt (24) being connected to an attachment body (22) and including a peripheral edge (32)
 

said attachment body (22) **characterized by** having a bore (34) therein for slidable insertion over a nozzle (12) of an abrasive polisher (14) providing a stream of abrasive powders, said attachment body (22) being supported by said nozzle (12), said attachment body (22) having an internal chamber (36) and including a tube (26) having a bore (38) in communication with the chamber (36), said tube (26) being connectable to a container for holding spent abrasive powder and residue removed from the surface (50).
2. The attachment of claim 1, wherein said attachment body (22) and said flexible skirt (24) are removable from the nozzle (12).
3. The attachment of claim 2, wherein said attachment body (22) is formed of a rigid plastic and said tube (26) is formed integral with a sidewall thereof, and an opening through the sidewall of the attachment body (22) connects the bore (38) of said tube (26) to the enclosed area (52) of the flexible skirt (24).
4. The attachment of claim 2, further including a stop mechanism (70, 90) for axially fixing the attachment body (22) with respect to the nozzle (12).
5. The attachment of claim 1, further including in combination an ultrasonic abrasive polisher (14) having an outer tube carrying a stream of water (20) for providing cavitation action with the abrasive powder.
6. The attachment of claim 1, wherein said attachment body (22) comprises a plastic member having a first end engagable around the nozzle (12) and a second end for receiving thereon the flexible skirt (24) and a bore from the first end to the second end, and the tube (26) is formed integral with the plastic member and wherein a source of suction (30) is coupled to the tube (26) to enhance a circulation path of the abrasive powder for removal thereof.
7. The attachment of claim 1, wherein the attachment body (22) is threadedly engaged with the nozzle (12).
8. The attachment of claim 1, wherein the attachment body (22) is friction fit to the nozzle (12).
9. The attachment of claim 1, further including a stop member (74, 90) secured to the nozzle (12) to prevent axial movement of the attachment body (22) along the nozzle (12).
10. The attachment of claim 1, wherein the flexible skirt (24) is constructed so as to be removably attached to the attachment body (22) and replaced with a new flexible skirt (24).
11. The attachment of claim 10, wherein the flexible skirt (24) and the attachment body (22) include a groove (40) and lip (42) engagement arrangement for removably fastening the flexible skirt (24) to the attachment body (22).
12. The attachment of claim 1, wherein the attachment body (22) includes a first axial bore (34) with a diameter friction fittable to the nozzle (12), and a second axial bore (36) having a diameter larger than the first axial bore (34), an internal sidewall of said second axial bore (36) being radially spaced from a portion of the nozzle (12) that passes through the first axial bore (34) to thereby define a portion of a chamber (52).

13. The attachment of claim 1, further including in combination an angled nozzle (12) of the abrasive polisher (14), and said attachment body (22) includes a cupped portion (64) for receiving a corresponding portion of the angled nozzle (12) to thereby prevent rotation of the attachment body (22) with respect to the angled nozzle (12). 5
14. The attachment of claim 1, further including in combination a shouldered nozzle (72) of the abrasive polisher (14), and said attachment body (70) includes a bore (78) for receiving the shouldered nozzle (72) therein, and an inwardly directed stop (76) formed in the bore (82) for abutting with a shoulder member (74) of the nozzle (72). 10 15
15. The attachment of claim 1, wherein said flexible skirt (24) includes radial webs (44) directed inwardly for providing radial support to prevent collapsing of the flexible skirt (24) when subjected to suction. 20
16. The attachment of claim 1, further including in combination a source of suction (30) connected to the tube (26) of the attachment body (22) to facilitate a continuous suction circulation path for removal and containment of the abrasive powders. 25
17. The attachment of claim 1, wherein:  
 said nozzle (12) is tubular;  
 said attachment body (22) is rigid and has a first axial bore (34) with a diameter for inserting the attachment body (22) over the tubular nozzle (12), a second axial bore (36) of a diameter greater than the first bore (34) such that an internal sidewall of the second bore (36) is radially spaced from the tubular nozzle (12) which extends through the first bore (34), said radial space being annular and defining a suction chamber (36);  
 said suction tube (26) formed integral with said attachment body (22), said suction tube (26) having a bore (38) in communication with said suction chamber (36), said suction tube (26) being connectable to a source of suction (30); and  
 said flexible skirt (24) being removably attached to the attachment body (22) so as to be replaceable with a new flexible skirt (24), said flexible skirt (24) being generally hollow such that said suction chamber (36) is extended into said flexible skirt (24), said flexible skirt (24) including a flexible peripheral edge (32) engageable with the surface (50) to be polished to provide the confined area (52) influenced by the suction chamber (36) so that abrasive powder residue is removed via said suction chamber (36) to the suction source (30). 30 35 40 45 50 55
18. The attachment of claim 17, wherein said flexible skirt (24) is removably attached to said attachment body (22) by a groove (40) and lip (42) arrangement.
19. A method of polishing a surface (50) with an abrasive powder, **characterized by**  
 fastening a replaceable flexible skirt (24) to an attachment body (22) according to claim 1 and fastening the attachment body (22) to an abrasive polisher (14);  
 orienting a nozzle (12) toward the surface (50) and directing an air-driven stream of the abrasive powder from the nozzle (12) to the surface; sealing the nozzle (12) to a portion of the surface (50) to be polished with the flexible skirt (24) so as to contain the abrasive powder and prevent escape of airborne powder residue between the flexible skirt (24) and the surface (50) to be polished;  
 circulating the air-driven stream of abrasive powder from the surface (50) to a container (30) to remove the contained airborne powder residue from the flexible skirt (24); and  
 removing the flexible skirt (24) after use from the attachment body (22) and attaching a new flexible skirt (24) to the attachment body (22).
20. The method of Claim 19, further including applying a suction (30) to a contained area (52) between the surface (50) and the flexible skirt (24) via the attachment member (22) to facilitate the circulation of the abrasive powder.

#### Patentansprüche

1. Zusatzgerät (10) zur Verwendung bei der Bearbeitung einer Oberfläche (50) eines Werkstückes, das eine flexible Schürze (24) zum Anlegen an der zu bearbeitenden Oberfläche (50) und zum Schaffen eines eingeschlossenen Raumes (52) um die zu bearbeitende Oberfläche (50) herum, eine Unterdruckquelle (30), die mit dem eingeschlossenen Raum (52) über die flexible Schürze (24) verbunden ist, wobei die flexible Schürze (24) mit einem Zusatzgerätkörper (22) verbunden ist, und einen Umfangsrand (32) aufweist, wobei der Zusatzgerätkörper (22) **dadurch gekennzeichnet ist, daß** er darin eine Bohrung (34) zum gleitenden Aufschieben über eine Düse (12) eines Schleifpolierers (14) hat, der einen Strom von Schleifpulvern bereitstellt, wobei der Zusatzgerätkörper (22) von der Düse (12) getragen wird, wobei der Zusatzgerätkörper (22) eine innere Kammer (36) und ein Rohr (26) mit einer Bohrung (38) in Verbindung mit der Kammer (36) aufweist, - wobei das

- Rohr (26) mit einem Behälter zum Aufnehmen von verbrauchtem Schleifpulver und von von der Oberfläche (50) entfernten Rückständen verbindbar ist.
2. Zusatzgerät nach Anspruch 1, wobei der Zusatzgerätkörper (22) und die flexible Schürze (24) von der Düse (12) entfernbar sind. 5
  3. Zusatzgerät nach Anspruch 2, wobei der Zusatzgerätkörper (22) aus einem steifen Kunststoff gebildet ist und das Rohr (26) in einem Stück mit einer Seitenwand davon gebildet ist und eine Öffnung durch die Seitenwand des Zusatzgerätkörpers (22) die Bohrung (38) des Rohres (26) mit dem eingeschlossenen Raum (52) der flexiblen Schürze (24) verbindet. 10 15
  4. Zusatzgerät nach Anspruch 2, das ferner einen Anschlagmechanismus (70, 90) zum axialen Fixieren des Zusatzgerätkörpers (22) in Bezug auf die Düse (12) aufweist. 20
  5. Zusatzgerät nach Anspruch 1, das ferner in Kombination einen Ultraschall-Schleifpolierer (14) mit einer äußeren Leitung aufweist, die einen Strom von Wasser (20) führt, um mit dem Schleifpulver eine Kavitationswirkung bereitzustellen. 25
  6. Zusatzgerät nach Anspruch 1, wobei der Zusatzgerätkörper (22) ein Kunststoffteil umfaßt, das ein erstes, um die Düse (12) in Eingriff bringbares Ende und ein zweites Ende, um darauf die flexible Schürze (24) aufzunehmen, und eine Bohrung von dem ersten Ende zu dem zweiten Ende aufweist, und wobei das Rohr (26) in einem Stück mit dem Kunststoffteil gebildet ist und wobei die Unterdruckquelle (30) mit dem Rohr (26) verbunden ist, um einen Kreislaufweg des Schleifpulvers für dessen Entfernung zu verbessern. 30 35 40
  7. Zusatzgerät nach Anspruch 1, wobei der Zusatzgerätkörper (22) mit der Düse (12) über Gewinde in Eingriff steht.
  8. Zusatzgerät nach Anspruch 1, wobei der Zusatzgerätkörper (22) kraftschlüssig an der Düse (12) befestigt ist. 45
  9. Zusatzgerät nach Anspruch 1, das ferner eine an der Düse (12) befestigte Anschlagkomponente (74, 90) aufweist, um eine axiale Bewegung des Zusatzgerätkörpers (22) entlang der Düse (22) zu verhindern. 50
  10. Zusatzgerät nach Anspruch 1, wobei die flexible Schürze (24) so ausgestaltet ist, daß sie entfernbar an dem Zusatzgerätkörper (22) angebracht ist und durch eine neue flexible Schürze (24) ersetzbar ist. 55
  11. Zusatzgerät nach Anspruch 10, wobei die flexible Schürze (24) und der Zusatzgerätkörper (22) eine Eingriffsanordnung mit Nut (40) und Lippen (42) zum entfernbaren Befestigen der flexiblen Schürze (24) an dem Zusatzgerätkörper (22) aufweisen.
  12. Zusatzgerät nach Anspruch 1, wobei der Zusatzgerätkörper (22) eine erste axiale Bohrung (34) mit einem Durchmesser, der kraftschlüssig an der Düse (12) anbringbar ist, und eine zweite axiale Bohrung (36) mit einem Durchmesser aufweist, der größer als der der ersten axialen Bohrung (34) ist, wobei eine innere Seitenwand der zweiten axialen Bohrung (36) radial von einem Bereich der Düse (12) beabstandet ist, die durch die erste axiale Bohrung (34) verläuft, um dadurch einen Bereich einer Kammer (52) zu bilden.
  13. Zusatzgerät nach Anspruch 1, das ferner in Kombination eine abgewinkelte Düse (12) des Schleifpolierers (14) umfaßt, und wobei der Zusatzgerätkörper (22) einen hohlen Bereich (64) zum Aufnehmen eines entsprechenden Bereiches der abgewinkelten Düse (12) umfaßt, um dadurch eine Drehung des Zusatzgerätkörpers (22) in Bezug auf die abgewinkelte Düse (12) zu verhindern.
  14. Zusatzgerät nach Anspruch 1, das ferner in Kombination eine mit einer Schulter versehene Düse (72) des Schleifpolierers (14) umfaßt, und wobei der Zusatzgerätkörper (70) eine Bohrung (78), um darin eine mit einer Schulter versehene Düse (72) aufzunehmen, und einen nach innen gerichteten, in der Bohrung gebildeten Anschlag (76) zum Anstoßen an ein Schulterteil (74) der Düse (72) umfaßt.
  15. Zusatzgerät nach Anspruch 1, wobei die flexible Schürze (24) radiale, nach innen gerichtete Rippen (44) zum Bereitstellen einer radialen Unterstützung aufweist, um ein Kollabieren der flexiblen Schürze (24) zu verhindern, wenn sie einem Unterdruck ausgesetzt wird.
  16. Zusatzgerät nach Anspruch 1, das ferner in Kombination eine Unterdruckquelle (30) aufweist, die mit dem Rohr (26) des Zusatzgerätkörpers (22) verbunden ist, um einen kontinuierlichen Unterdruck-Umlaufweg zum Entfernen und Einschließen der Schleifpulver zu ermöglichen.
  17. Zusatzgerät nach Anspruch 1, wobei:  

die Düse (12) rohrförmig ist;  
 der Zusatzgerätkörper (22) starr ist und eine erste axiale Bohrung (34) mit einem Durchmesser zum Aufschieben des Zusatzgerätkörpers (22) über die rohrförmige Düse (12) und eine zweite axiale Bohrung (36) eines Durchmes-



sers aufweist, der größer als der der ersten Bohrung (34) ist, so daß eine innere Seitenwand der zweiten Bohrung (36) radial von der rohrförmigen Düse (12), die durch die erste Bohrung (34) verläuft, beabstandet ist, wobei der radiale Abstandsraum ringförmig ist und eine Unterdruckkammer (36) bildet; das Saugrohr (26) in einem Stück mit dem Zusatzgerätkörper (22) gebildet ist, wobei das Saugrohr (26) eine Bohrung (38) in Verbindung mit der Unterdruckkammer (36) aufweist, wobei das Saugrohr (26) mit einer Unterdruckquelle (30) verbindbar ist; und die flexible Schürze (24) entfernbar an dem Zusatzgerätkörper (22) angebracht ist, so daß sie durch eine neue flexible Schürze (24) ersetzbar ist, wobei die flexible Schürze (24) im wesentlichen hohl ist, so daß die Unterdruckkammer (36) in die flexible Schürze (24) reicht, wobei die flexible Schürze (24) einen flexiblen Umfangsrand (32) aufweist, der mit der zu polierenden Oberfläche (50) in Anlage bringbar ist, um einen eingeschlossenen Raum (52) zu schaffen, der durch die Unterdruckkammer (36) beeinflusst wird, so daß Schleifpulver-Rückstände über die Unterdruckkammer (36) zu der Unterdruckquelle (30) abgeführt werden.

18. Zusatzgerät nach Anspruch 17, wobei die flexible Schürze (24) durch eine Anordnung mit Nut (40) und Lippen (42) entfernbar an dem Zusatzgerätkörper (22) angebracht ist.

19. Verfahren zum Polieren einer Oberfläche (50) mit einem Schleifpulver, **gekennzeichnet durch:**

Befestigen einer entfernbar flexiblen Schürze (24) an einem Zusatzgerätkörper (22) gemäß Anspruch 1 und Anbringen des Zusatzgerätkörpers (22) an einem Schleifpolierer (14); Richten einer Düse (12) auf die Oberfläche (50) und Lenken eines luftgetriebenen Stromes des Schleifpulvers von der Düse (12) auf die Oberfläche;

Abdichten der Düse (12) gegen einen Bereich der zu polierenden Oberfläche (50) mit der flexiblen Schürze (24), um das Schleifpulver einzuschließen und das Entweichen von schwebenden Pulverresten zwischen der flexiblen Schürze (24) und der zu polierenden Oberfläche (50) zu verhindern;

Zirkulieren des luftgetriebenen Stromes von Schleifpulver von der Oberfläche (50) zu einem Behälter (30), um die eingeschlossenen schwebenden Pulverreste aus der flexiblen Schürze (24) zu entfernen; und Entfernen der flexiblen Schürze (24) von dem

Zusatzgerätkörper (22) nach der Verwendung und Anbringen einer neuen flexiblen Schürze (24) an dem Zusatzgerätkörper (22).

20. Verfahren nach Anspruch 19, das ferner das Anlegen eines Unterdruckes (30) an einen eingeschlossenen Raum (52) zwischen der Oberfläche (50) und der flexiblen Schürze (24) über das Zusatzgerät (22) umfaßt, um die Zirkulation des Schleifpulvers zu erleichtern.

# Revendications

1. Attache (10) destinée à être utilisée pour préparer une surface (50) d'une pièce, comprenant une jupe souple (24) permettant de coopérer avec la surface (50) à préparer et fournissant une zone close (52) autour de la surface (50) à préparer, une source (30) d'aspiration couplée à la zone close (52) par l'intermédiaire de la jupe souple (24), ladite jupe souple (24) étant raccordée à un corps d'attache (22) et incluant un bord périphérique (32), ledit corps d'attache (22) étant **caractérisé en ce qu'il** possède un alésage (34) prévu dans celui-ci pour une insertion, par coulisement, sur une buse (12) d'une polisseuse abrasive (14) fournissant un jet de poudres abrasives, ledit corps d'attache (22) étant supporté par ladite buse (12), ledit corps d'attache (22) possédant une chambre intérieure (36) et incluant un tube (26) possédant un alésage (38) en communication avec la chambre (36), ledit tube (26) pouvant être raccordé à un conteneur permettant de stocker la poudre abrasive utilisée et les résidus enlevés de la surface (50).

2. Attache selon la revendication 1, dans laquelle ledit corps d'attache (22) et ladite jupe flexible (24) peuvent être enlevés de la buse (12).

3. Attache selon la revendication 2, dans laquelle ledit corps d'attache (22) est formé dans un plastique rigide et ledit tube (26) est formé en une seule pièce avec une paroi latérale de celui-ci, et une ouverture pratiquée à travers la paroi latérale du corps d'attache (22) raccorde l'alésage (38) dudit tube (26) à la zone close (52) de la jupe souple (24).

4. Attache selon la revendication 2, incluant en outre un mécanisme d'arrêt (70, 90) permettant de fixer, axialement, le corps d'attache (22) par rapport à la buse (12).

5. Attache selon la revendication 1, incluant en outre, en combinaison, une polisseuse abrasive à ultrasons (14) possédant un tube extérieur portant un jet d'eau (20) afin de fournir une action de cavitation avec la poudre abrasive.

6. Attache selon la revendication 1, dans laquelle ledit corps d'attache (22) comprend un élément de plastique possédant une première extrémité qui peut s'engager autour de la buse (12) et une seconde extrémité permettant de recevoir la jupe souple (24) et un alésage, entre la première extrémité et la seconde extrémité, et le tube (26) est formé en une seule pièce avec l'élément de plastique et dans laquelle une source d'aspiration (30) est couplée au tube (26) afin de renforcer un trajet de circulation de la poudre abrasive afin d'enlever celle-ci. 5
7. Attache selon la revendication 1, dans laquelle le corps d'attache (22) coopère, par filetage, avec la buse (12). 10
8. Attache selon la revendication 1, dans laquelle le corps d'attache (22) est ajusté par friction sur la buse (12). 15
9. Attache selon la revendication 1, incluant en outre un élément d'arrêt (74, 90) assujéti sur la buse (12) afin d'empêcher un mouvement axial du corps d'attache (22) le long de la buse (12). 20
10. Attache selon la revendication 1, dans laquelle la jupe souple (24) est conçue de façon à être fixée, pour pouvoir être enlevée, sur le corps d'attache (22) et remplacée par une nouvelle jupe flexible (24). 25
11. Attache selon la revendication 10, dans laquelle la jupe souple (24) et le corps d'attache (22) incluent un agencement de coopération de rainure (40) et de lèvre (42) afin de fixer, pour qu'elle puisse être enlevée, la jupe souple (24) sur le corps d'attache (22). 30
12. Attache selon la revendication 1, dans laquelle le corps d'attache (22) inclut un premier alésage axial (34) ayant un diamètre qui peut être ajusté par friction sur la buse (12), et un second alésage axial (36) ayant un diamètre plus grand que le premier alésage axial (34), une paroi latérale intérieure dudit second alésage axial (36) étant espacé, radialement, d'une partie de la buse (12) qui traverse le premier alésage axial (34) afin de définir ainsi une partie d'une chambre (52). 35
13. Attache selon la revendication 1, incluant en outre en combinaison une buse à jet dévié (12) de la polisseuse abrasive (14), et ledit corps d'attache (22) inclut une partie en forme de coupelle (64) permettant de recevoir une partie correspondante de la buse à jet dévié (12) afin d'empêcher ainsi la rotation du corps d'attache (22), par rapport à la buse à jet dévié (12). 40
14. Attache selon la revendication 1, comprenant en outre en combinaison une buse à épaulement (72) de la polisseuse abrasive (14), et ledit corps d'attache (70) inclut un alésage (78) permettant de recevoir la buse à épaulement (72), et une butée orientée vers l'intérieur (76) formée dans l'alésage (82) afin de buter contre un élément d'épaulement (74) de la buse (72). 45
15. Attache selon la revendication 1, dans laquelle ladite jupe souple (24) inclut une structure radiale (44) orientée vers l'intérieur afin de fournir un support radial pour empêcher l'écrasement de la jupe souple (24) lorsque celle-ci est soumise à une aspiration. 50
16. Attache selon la revendication 1, incluant, en outre, en combinaison, une source d'aspiration (30) raccordée au tube (26) du corps d'attache (22) afin de faciliter un trajet de circulation d'aspiration continue pour enlever et contenir les poudres abrasives. 55
17. Attache selon la revendication 1, dans laquelle :  
 ladite buse (12) est tubulaire ;  
 ledit corps d'attache (22) est rigide et possède un premier alésage axial (34) ayant un diamètre permettant d'insérer le corps d'attache (22) sur la buse tubulaire (12), un second alésage axial (36) ayant un diamètre plus grand que le premier alésage (34) de telle sorte qu'une paroi latérale intérieure du second alésage (36) est espacée, radialement, de la buse tubulaire (12) qui s'étend à travers le premier alésage (34), ledit espace radial étant annulaire et définissant une chambre d'aspiration (36) ;  
 ledit tube d'aspiration (26) formé en une seule pièce avec ledit corps d'attache (22), ledit tube d'aspiration (26) possédant un alésage (38) en communication avec ladite chambre d'aspiration (36), ledit tube d'aspiration (26) pouvant être raccordé à une source d'aspiration (30) ; et  
 ladite jupe souple (24) étant fixée, pour pouvoir être enlevée, sur le corps d'attache (22) de façon à pouvoir être remplacée par une nouvelle jupe souple (24), ladite jupe souple (24) étant, de manière générale, creuse, de telle sorte que ladite chambre d'aspiration (36) s'étend dans ladite jupe souple (24), ladite jupe souple (24) incluant un bord périphérique souple (32) qui peut s'engrener sur la surface (50) qui doit être polie afin de fournir la zone confinée (52) influencée par la chambre d'aspiration (36) de sorte que les résidus de poudre abrasive soient enlevés par l'intermédiaire de ladite chambre d'aspiration (36) vers la source d'aspiration (30).

18. Attache selon la revendication 17, dans laquelle ladite jupe souple (24) est fixée, pour pouvoir être enlevée, sur ledit corps d'attache (22) par un agencement de rainure (40) et de lèvre (42).

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19. Procédé de polissage d'une surface (50) avec une poudre abrasive, **caractérisé par** :

la fixation d'une jupe souple (24) remplaçable sur un corps d'attache (22) selon la revendication 1, et la fixation du corps d'attache (22) sur une polisseuse abrasive (14) ; 10  
l'orientation d'une buse (12) vers la surface (50) et la direction d'un jet pneumatique de poudre abrasive entre la buse (12) et la surface ; 15  
la mise en contact étanche de la buse (12) sur une partie de la surface (50) à polir avec la jupe souple (24) de façon à contenir la poudre abrasive et empêcher la fuite des résidus de poudre abrasive entre la jupe souple (24) et la surface (50) à polir; 20  
la circulation du jet pneumatique de poudre abrasive entre la surface (50) et un conteneur (30) afin d'enlever, de la jupe souple (24), les résidus de poudre en suspension dans l'air ; et 25  
l'enlèvement de la jupe souple (24), après son utilisation, du corps d'attache (22) et la fixation d'une nouvelle jupe souple (24) sur le corps d'attache (22).

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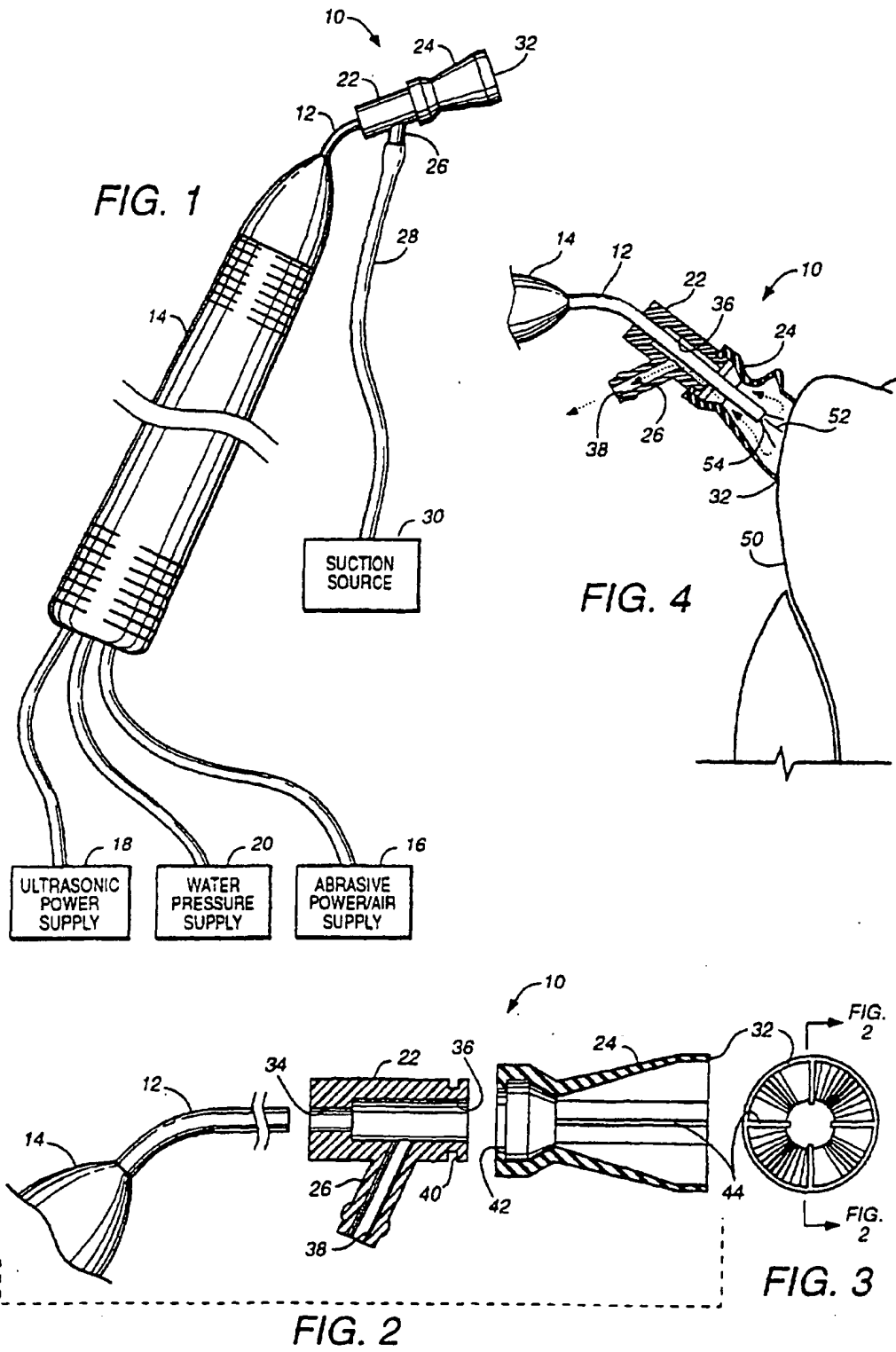
20. Procédé selon la revendication 19, incluant en outre l'application d'une aspiration (30) à une zone confinée (52) entre la surface (50) et la jupe souple (24) par l'intermédiaire de l'élément de fixation (22) afin de faciliter la circulation de la poudre abrasive. 35

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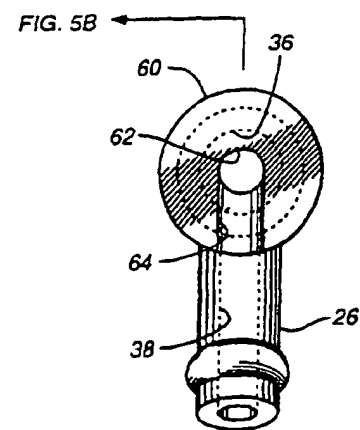


FIG. 5A

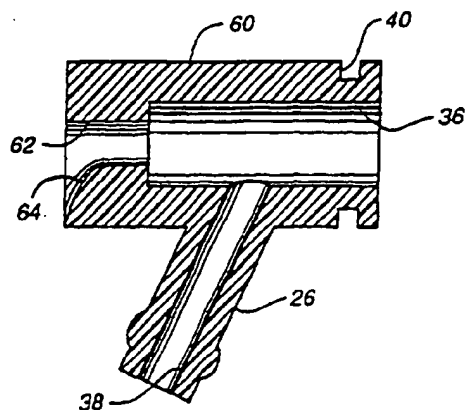


FIG. 5B

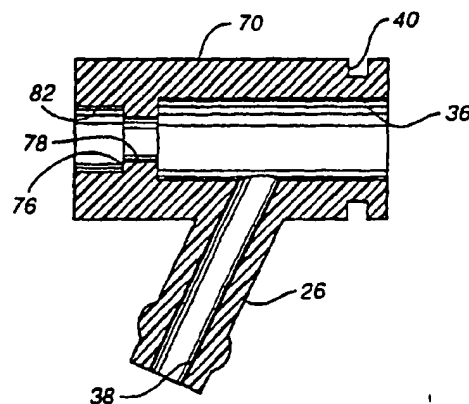
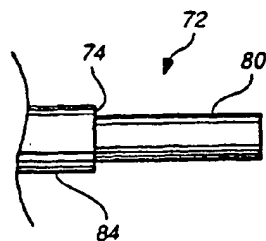


FIG. 6

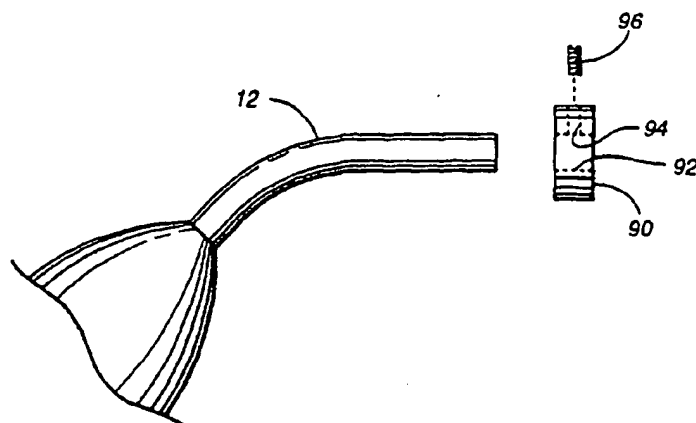


FIG. 7